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Superfund Innovative Technology Evaluation (SITE) after the First Year

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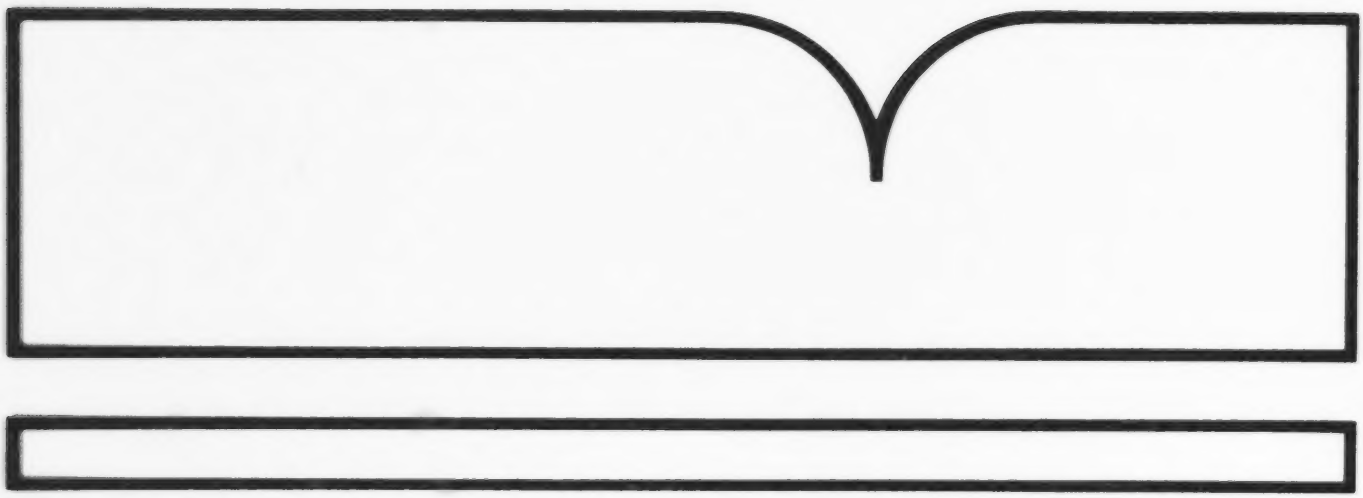

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SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION (SITE) AFTER THE FIRST YEAR

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ABSTRACT

The U.S. Environmental Protection Agency's Office of Research and Development (ORD), joining with the Office of Solid Waste and Emergency Response (OSWER), has initiated the SITE program. The SITE program will help EPA find, test, and encourage the use of new ways to destroy, stabilize, or otherwise treat hazardous wastes, rather than just bury them in the ground. The overall goal of the SITE program is to maximize the use of alternatives to land disposal and containment at Superfund sites. To accomplish this goal, the program will provide reliable cost and performance information on technologies that offer an alternative to land disposal. This information will be generated by conducting pilot-scale or full-scale demonstrations of alternative technologies at Superfund sites. The SITE program has now been functioning over a year. Twelve technologies have been selected for the first series of demonstrations and twelve more are under review for the second series.

INTRODUCTION

The 1986 amendments to Superfund[1] create a comprehensive program of research, development, demonstration, and training to promote the development of alternative and innovative treatment technologies. The terms "alternative or innovative treatment technologies" are defined in the law to mean those technologies that permanently alter the composition of hazardous wastes through chemical, biological, or physical means so as to significantly reduce the toxicity, mobility, or volume. The terms also include technologies that characterize the extent and nature of site contamination and technologies that assess the stresses imposed by contaminants on

complex ecosystems at a site.

An Office of Technology Demonstration has been established to carry out this research and demonstration program. EPA is authorized to enter into contracts, grants, and cooperative agreements with public entities and private parties to carry out this program. Project selection is required to follow a schedule and procedures as specified in the law. The Agency can arrange for the use of actual Superfund sites for the research, testing, and demonstration projects. At least 10 field demonstration projects must be initiated each year.

In order to carry out this legislative mandate, EPA has established the Superfund Innovative Technology Evaluation (SITE) program. A strategy and program plan has been developed and published.[2] The SITE program was discussed at this Conference in 1986.[3]

The overall goal of the SITE program is to maximize the use of alternatives to land disposal in cleaning up Superfund sites and to encourage the development and demonstration of new, innovative treatment and monitoring technologies. The SITE program has been designed to accomplish the following objectives which correspond to the program's four parts:

1. To identify and remove impediments to the development and commercial use of alternative treatment technologies.

2. To demonstrate at full scale the more promising innovative technologies to establish reliable performance and cost information.

3. To develop procedures and policies that encourage selection of alternative treatment technologies for Superfund site cleanup.

4. To accelerate and promote further development of promising innovative technologies that are not yet ready for full-scale demonstration.

This paper will concentrate on the demonstration aspect of the program.

DEMONSTRATION PROGRAM

The purpose of the demonstration and evaluation of selected technologies is to develop performance, cost-effectiveness, and reliability data so that Superfund decision-makers can make sound judyments as to the applicability of the technology to a particular site. The results of the demonstrations should identify the limitations of the technology, the wastes and media to which it can be applied, the operating procedures, and the approximate capital and operating costs. The demonstrations will be carried out at full scale or at a scale that allows valid comparison and direct scale-up to commercial size units. The duration of the demonstration will be determined on a case by case basis but must be of a sufficient time to adequately characterize equipment reliability and operational variabilities.

SITE demonstrations will usually be conducted at actual uncontrolled hazardous waste sites including Superfund sites, state sites, sites from other Federal agencies, and private party sites. Occasionally, demonstrations will be conducted at EPA operated test and evaluation (T&E) facilities. These T&E facilities would have adequate pollution control and safety equipment in place so that technologies could be evaluated over a wide range of operation without pollutant releases outside of the facility. The T&E facilities could provide for faster testing of smaller and moderate size units under safe and controlled conditions at a lower cost. The tests conducted in these facilities would be on wastes brought in from an actual hazardous waste site.

No Federal, state, or local permits will be required for any demonstration carried out at actual Superfund sites. However, the demonstration will comply with all legally applicable or relevant and appropriate standards (as these terms are defined in Superfund in relationship to protection of the environment and health). Permits will be required for demonstrations at all other sites.

The funding of the demonstration will be cost-shared between EPA and the applicant. Usually, the technology developer will be expected to pay the costs to transport, erect, and operate the equipment on site and dismantle and remove the equipment at the end of the demonstration. EPA will pay for the costs of sampling and analysis, quality assurance and quality control, evaluating data, and preparing reports. EPA will also assist the developer to obtain whatever permits are required. Normally, there will be no exchange of funds between the Agency and the applicant. In a few instances where the technology is very unique, unusually promising, and high in financial risk, EPA will consider bearing a greater portion of the total project cost if the developer is unable to obtain financing elsewhere.

At the completion of the demonstration, EPA will undertake activities to encourage wide-scale use of the successful technologies in the Superfund cleanup program. The Agency will evaluate the application of these technologies to other sites and to wastes other than those tested. A technology transfer and technical assistance program will transmit results to potential users within and outside of the Agency.

EPA has issued two requests for projects under the demonstration program--one in 1986 and the second in January 1987. It is the intent of the program to have at least one solicitation per year. The first solicitation in 1986 produced 21 responses from which 10 technologies were selected for the program. In addition, other technologies were added upon presentation and review by EPA. The first set of technologies selected into the SITE program (SITE-001) can be summarized as follows:

Thermal - 5

Extraction - 2

Stabilization/Solidification - 2

Biological - 1

These technologies are discussed later in this paper.

The second solicitation (SITE-002) in 1987 resulted in 29 responses. Of these, 12 have been conditionally acceptable and several others have been found to have potential merit and the developer requested that they rewrite their proposal. The conditionally acceptable technologies fall into the following categories:

Thermal - 2

Extraction - 1

Stabilization/Solidification - 4

Biological - 4

Chemical - 1

Final selection for SITE-002 will occur in the fall of 1987 and the demonstrations should take place in late 1988.

The SITE-001 projects should enter the demonstration stages in the fall of 1987 and the spring/summer of 1988. A description of these technologies follows:

TECHNOLOGIES

Electric Infrared Furnace

This thermal treatment process developed by Shirco Infrared Systems, Inc., uses a primary chamber where infrared energy is provided by electrically powered silicon carbide rods. Temperatures in the primary chamber can reach 1850°F and residence times can range from 10 to 90 minutes. Organic materials volatilized in the primary chamber enter a secondary chamber where combustion is completed at temperatures up to 2300°F and 2 seconds gas residence time. Exhaust gases then

pass through a venturi scrubber spray tower.

There are over 40 infrared systems installed throughout the world used for incineration of municipal and industrial sludges and activated carbon regeneration. A portable pilot unit, housed in a 45-foot van trailer and capable of processing 30 to 100 lbs/hour, has been built and tested at several hazardous waste sites. The SITE demonstration will involve a unit capable of processing between 100 and 250 tons/day to treat PCB-contaminated soils at a site in Florida and a small unit to treat soils at a site in EPA Region V. Both systems are mobile and mounted on wheels for highway transportation by truck and can be installed at a site in several weeks.

The infrared furnace is designed to incinerate soil or sludge contaminated with organic hazardous constituents such as PCB's, pesticides, and dioxins. At Times Beach, Missouri, the portable system achieved a destruction and removal efficiency (DRE) of 99.999996 percent on soil containing 227 ppb of 2,3,7,8 TCDD. At Joplin, Missouri, the portable infrared furnace was used to decontaminate creosote sludges and achieved a DRE of 99.99999 percent on pentachlorophenol and 99.99% on napthalene.

Circulating Bed Combustor

This advanced fluidized bed incinerator was developed by GA Technologies and is now owned by Ogden Environmental Services. High velocity air suspends a bed of solid particles in the combustion chamber. This creates a highly turbulent combustion zone with temperatures in the range of 1450°F to 2000°F into which solid or liquid waste feeds can be introduced. Solidified materials have a residence time of 30 minutes while gases have a residence time of 2 seconds. There is no afterburner. The suspended bed materials (and waste solids) that leave the combustion chamber are recovered in a cyclone and recirculate through the furnace. The

exhaust gases pass through a convective gas cooler and flue gas filter.

There are approximately 30 circulating bed combustors operating world-wide burning materials such as high sulfur coal, peat, wood, waste oils, and municipal waste. A transportable pilot unit with soil feed rates of 400 lbs/hour achieved a DRE of 99.9999 percent on soils contaminated with PCB's at 12,000 ppm. A permit to destroy PCB's has been issued to this unit under the Toxic Substances Control Act. Test burns were also conducted on a mixture of organic liquids and several halogenated compounds. DRE's of at least 99.99 percent were achieved for Freon 113, carbon tetrachloride, ethylbenzene, and xylene. The SITE demonstration will be conducted with a 2 million BTU/hour unit located in San Diego, California. Wastes from one or two Superfund sites in California will be used for the demonstration.

Electric Pyrolyzer

This system, proposed by Westinghouse Waste Technology Services Division, is designed for thermal destruction of organic hazardous wastes without combustion. The system operates through rapid transfer of energy to the waste material causing dissociation of the organic molecules into individual atoms. The pyrolyzer is designed to operate at temperatures up to 3250°F. Gas residence time can be controlled as necessary to destroy organic materials. Exhaust gases are treated in a water-cooled cyclone, baghouse filter, and venturi scrubber.

In addition to destroying organics, the pyrolysis system also reduces metals to their elemental state and all inorganic oxides, sulfides, and halides are fixed as liquid silicates. Solids fall into a molten bath which when cooled forms a vitrified material with very low leaching potential.

A prototype system has been constructed which can process from 5 to 20 tons/day of solid waste material with up to 10 percent organics and 25 percent water. The pyrolysis system can be in the form of a mobile unit; for example, a 100-ton/

day unit could be trailer-mounted and set up in a few days. A demonstration site has not yet been selected.

Solidification and Stabilization

In this process developed by Hazcon, Inc., liquid wastes or sludges are mixed with a cementitious material (such as flyash or cement kiln dust) and a proprietary reagent. The mixture becomes hardened within 10 to 15 minutes and the hazardous constituents are microencapsulated with significantly reduced leaching potential. Hazcon states that the process is applicable to hydrocarbon waste from refining operations, petrochemicals, residue from oil-based paint, solvents and greases, as well as inorganic wastes containing heavy metals. It can solidify wastes over a wide range of pH (wastes with pH from .95 to 14 have been treated in bench-scale tests) and there is no limit on moisture content.

The operation uses very simple and standard blending and mixing equipment available from machinery suppliers. A mobile field blending unit is available which can be set up at a site in a few hours. The resulting product can be extruded into drums or forms creating solid blocks, or it can be placed in-situ.

This solidification process has been used on wastes from several chemical companies. Under the SITE program, EPA is interested in demonstrating the applicability of this process to organic sludges and soils contaminated with organic materials. A Superfund site in Region III is being proposed for the demonstration.

Vacuum Extraction

Terra Vac, Inc. has developed a process for in-situ vacuum extraction of volatile contaminants from soils and groundwater. Extraction wells are placed in the unsaturated soil zone above the water table. A vacuum source is applied to the well and volatile organic compounds are drawn off. The gas stream is passed through an activated carbon adsorption system to control air emissions. The system

can also be used to pump groundwater to the surface for treatment by spray aeration.

Vacuum extraction should provide advantages in situations where excavation of contaminated soils is impractical or very costly. It was used to clean up a spill of carbon tetrachloride from a ruptured underground storage tank. The vacuum extraction rate of carbon tetrachloride reached 250 pounds/day from an unsaturated soil zone 300 feet deep. After 30 months of operation, more than 70 percent of the spilled volume was removed from this zone. In other applications, methylene chloride and gasoline were successfully extracted from contaminated soils. A SITE demonstration is being developed in Region I to evaluate this process on soils contaminated with volatile organic compounds, hydrocarbons, and solvents.

Pyroplasma System

The pyroplasma process pyrolyzes wastes using a thermal plasma field. The heart of the system is a plasma arc torch which produces a thermal plasma with temperatures of more than 9000°F.

Waste liquids are injected directly into the plasma where the molecules are broken into their atomic states and the atoms then recombine to produce hydrogen, carbon monoxide, nitrogen, hydrogen chloride, particulate carbon, carbon dioxide, ethylene, and acetylene. The product gas is scrubbed with caustic soda to neutralize and remove the acid gases and remove particulates.

The pyroplasma system is capable of destroying any pumpable liquid organic waste. The system has been operated in a series of tests using methyl ethyl ketone, methanol, ethanol, carbon tetrachloride, and Askarel. The unit is not designed to destroy solids although it can handle up to 40 percent solids if they are pumpable and can pass through a 200-mesh screen. Heavy metals pass through the system in the scrubber water.

A mobile unit mounted on a 48-foot trailer is available and can process 2 to 3 gallons/minute.

Two SITE projects will use this technology. In one project, the New York State Department of Environmental Conservation and Pyrolysis Systems, Inc. will use a mobile plasma arc unit for the destruction of sludges from Love Canal. A second project will evaluate a larger unit developed by Westinghouse Plasma Systems. A site for the demonstration has not yet been selected.

Oxygen Enriched Burner

A proprietary burner developed by American Combustion Technologies, Inc. uses pure oxygen in combination with air and natural gas to destroy liquid hazardous waste. The use of oxygen allows higher temperatures which improves the kinetics of waste destruction, allows higher waste throughput, and reduces stack gas volume. Solids and sludges can be coincinerated when the burners are used in conjunction with rotary kiln furnaces.

The burner is capable of achieving temperatures as high as 5000°F and should be effective in destroying wastes which require high temperatures for destruction (e.g., halogenated organics) or have low heating values (small amounts of organic constituents in an inert base). Liquid waste particle size must be less than 1/32 in. and blending may be required to reduce viscosity.

A SITE demonstration of this burner is being planned at the EPA Combustion Research Facility in Jefferson, Arkansas.

In-Situ Stabilization

A SITE demonstration is being planned to evaluate the in-situ stabilization and solidification of soils contaminated with PCB's. The technology employed will be a chemical fixation process developed by International Waste Technologies which bonds organic and inorganic compounds in "macro molecules" which are resistant to

acids and naturally-existing deteriorating factors. After a test program to characterize the stabilized products, special drilling equipment developed in Japan will be used to inject and blend the stabilization media into the contaminated soils. Permeability, density, and leaching tests will be conducted. A PCB-contaminated soil site in Florida is being proposed for the demonstration.

Biological Degradation of Organic Contaminants

Biodegradation of organic contaminants in sludges and soils using proprietary, naturally-occurring microorganisms developed by Detox Industries, Inc., will be evaluated in another SITE demonstration. Detox has adapted microorganisms to biodegrade PCB's, PCP's, creosote, oils, phenolics, and PAH's. Particular naturally-occurring microorganisms are cultivated for accelerated growth and applied to the contaminant which is metabolized into carbon dioxide, water, and cell protoplasma.

A test project was reviewed by EPA's Region VI where 500 pounds of PCB-contaminated sludges, soils, and water were biodegraded. PCB levels were reduced to 4 ppm and as a result, the process was approved for use for the destruction of PCB's in the Region VI states.

A SITE demonstration on PCB-contaminated soils and sludges and PHA-contaminated material from Superfund sites is being planned.

REFERENCES

1. Superfund Amendments and Reauthorization Act of 1986, U.S. Congress.

2. Superfund Innovative Technology Evaluation (SITE) Strategy and Program Plan, EPA 540/G-86/001, U.S. Environmental Protection Agency, Washington, DC, Dec. 1986.

3. Hill, R. D., White, D.C., and Ogg, R. N., "Superfund Innovative Technology Evaluation Program," Proceedings: Management of Uncontrolled Hazardous Waste Sites, pp. 356-360, Hazardous Materials Control Research Institute, Silver Springs, Maryland, Dec. 1986.